BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

(12) UK Patent Application (19) GB (11) 2 361 972 (13) A

(43) Date of A Publication 07.11.2001

(21) Application No 0010808.4

(22) Date of Filing 05.05.2000

(71) Applicant(s)
Delphi Technologies Inc
(Incorporated in USA - Delaware)
5725 Delphi Drive, Troy, Michigan 48098-2815,
United States of America

(72) Inventor(s)
James Anthony Larkin

(74) Agent and/or Address for Service
Urquhart-Dykes & Lord
New Priestgate House, 57 Priestgate,
PETERBOROUGH, PE1 1JX, United Kingdom

(51) INT CL[7]
F16D 65/097

(52) UK CL (Edition S)
F2E EEL E2N1C1 E2N1C3

(56) Documents Cited
GB 2316985 A WO 98/25804 A US 5511638 A
US 5310024 A

(58) Field of Search
UK CL (Edition R) F2E EEL EHB
INT CL[7] F16D 65/097
ON-LINE: EPODOC, JAPIO, WPI

(54) Abstract Title

Method and apparatus for mounting friction elements in disc brakes

(57) A method and apparatus for mounting friction elements in spot-type disc brakes of the kind comprising at least one axially-slidable brake disc, comprises providing resilient means 44, for example a wire spring, mounted on the friction element and slidable therewith relative to a fixed caliper or bridge structure 34, whereby enhanced uniformity of spring force is obtained, together with the ability to provide for a suitably modified spring force in the case of a central friction element (20, Figure 1) provided between two slidable brake discs (12,14, Figure 1).

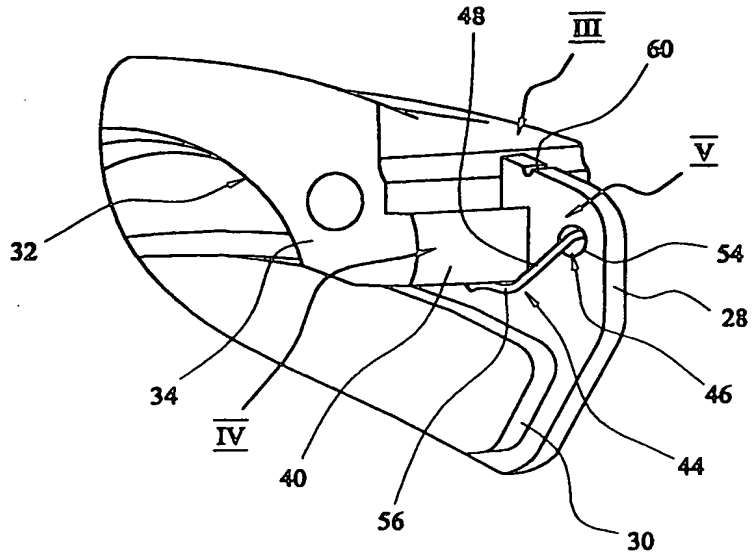


FIG. 2

GB 2 361 972 A

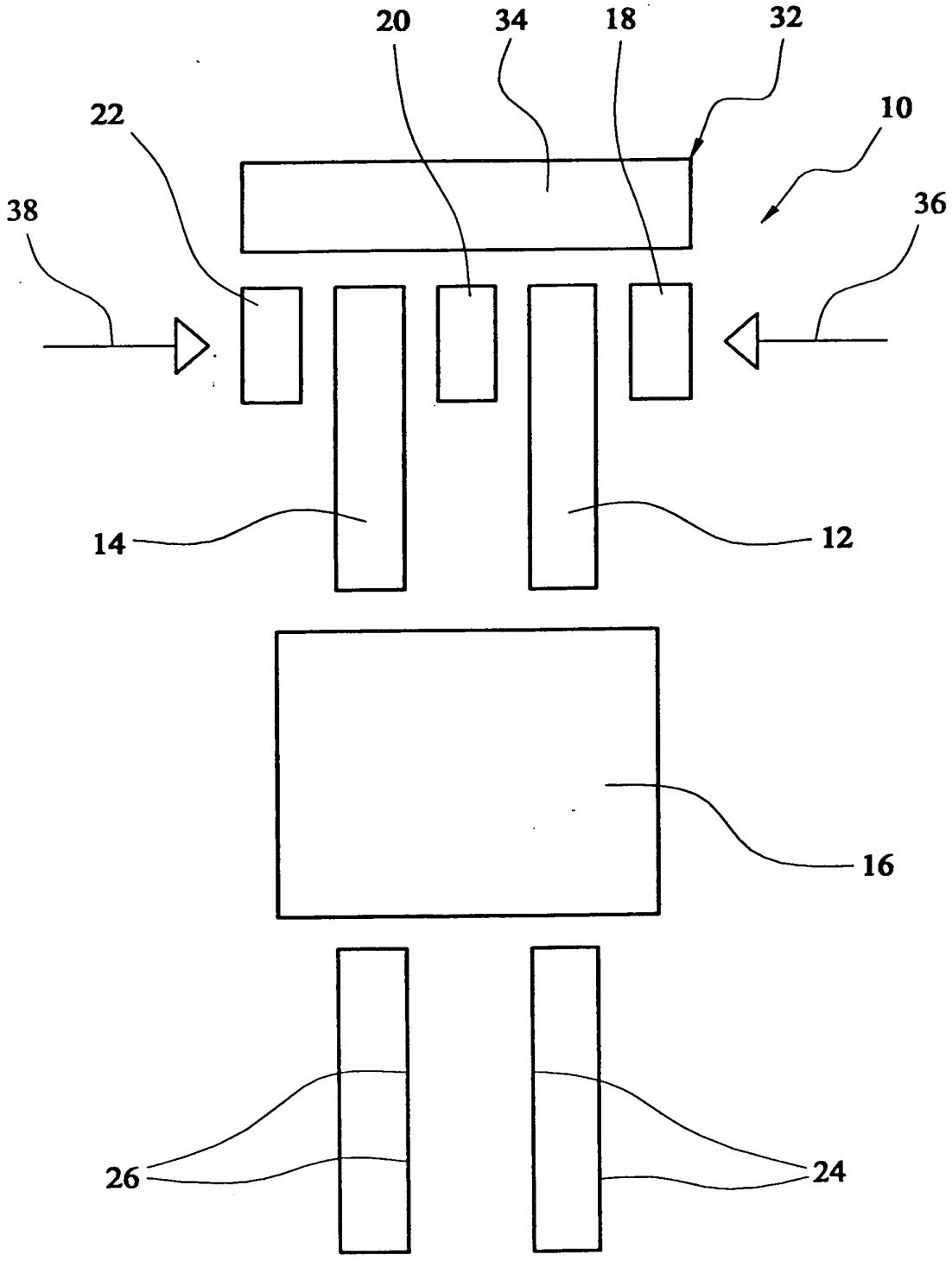


FIG. 1

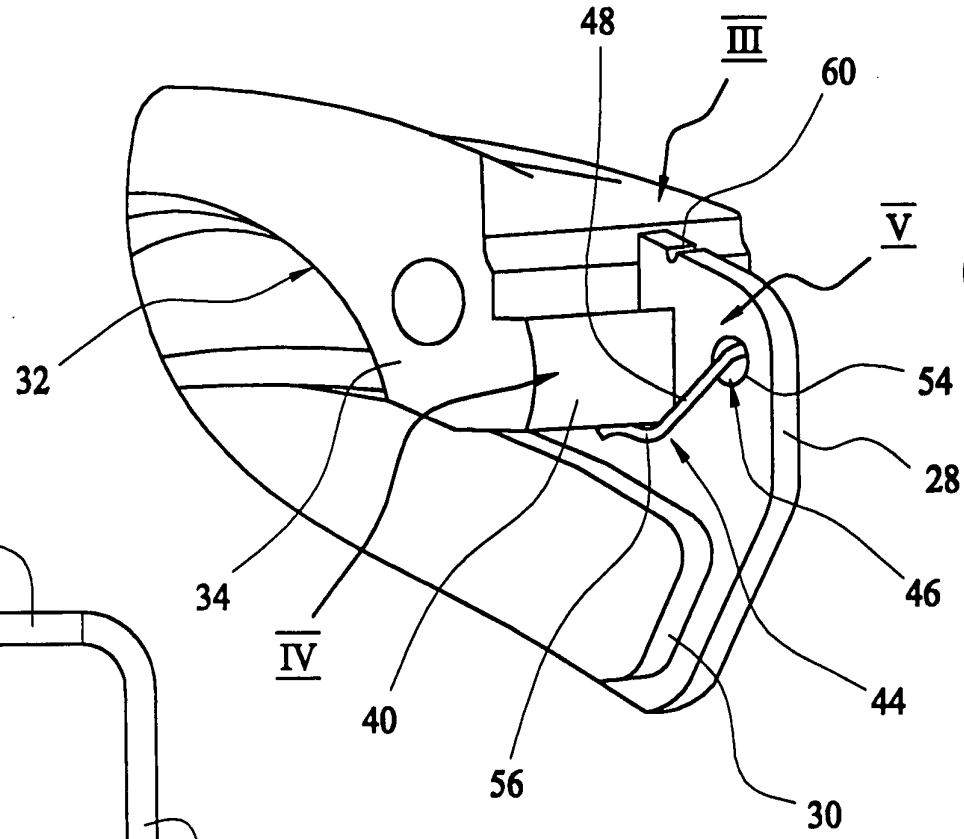


FIG. 2

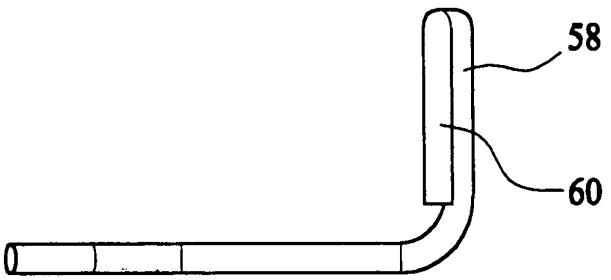


FIG. 3

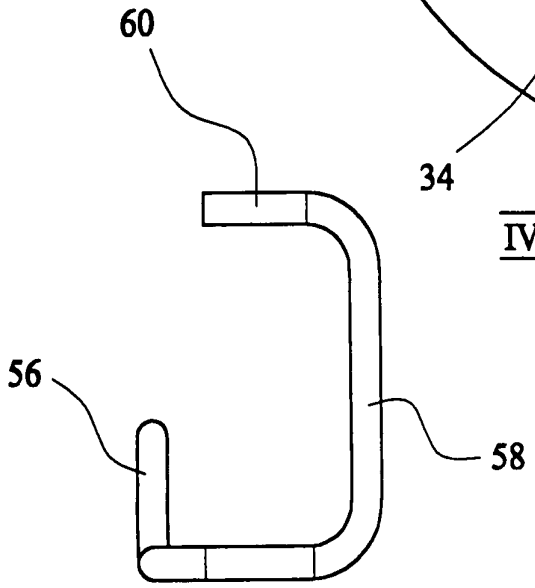


FIG. 5

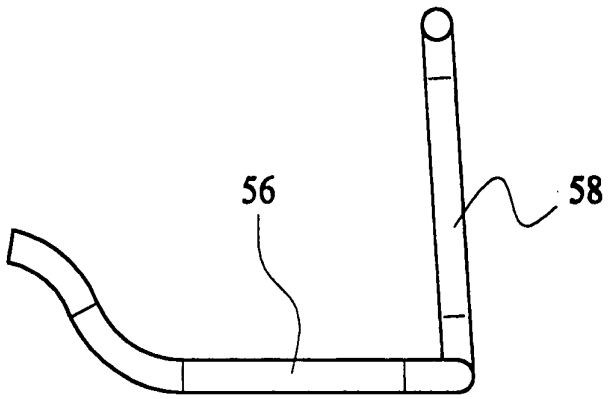


FIG. 4

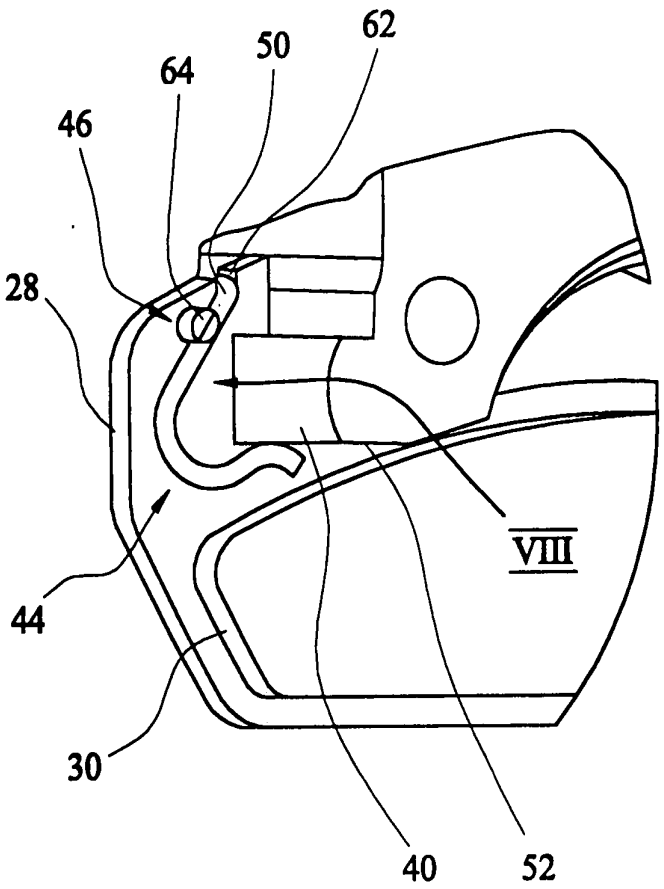
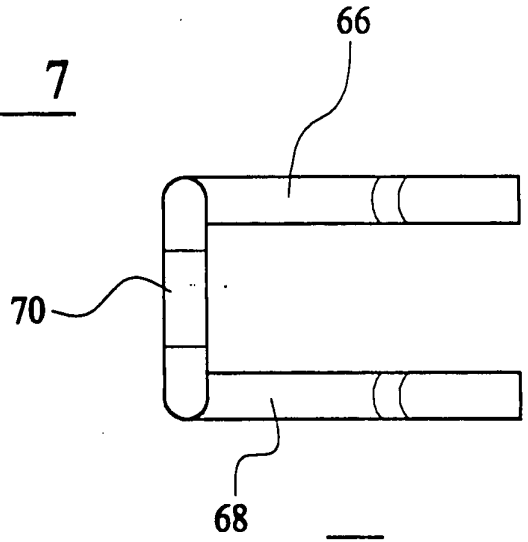


FIG. 6

FIG. 7



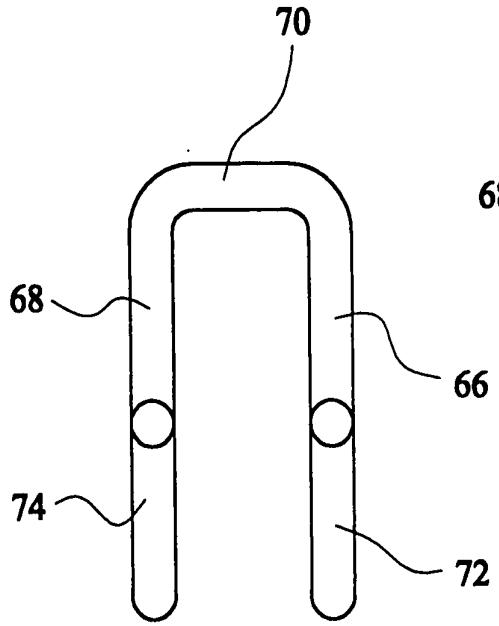


FIG. 9

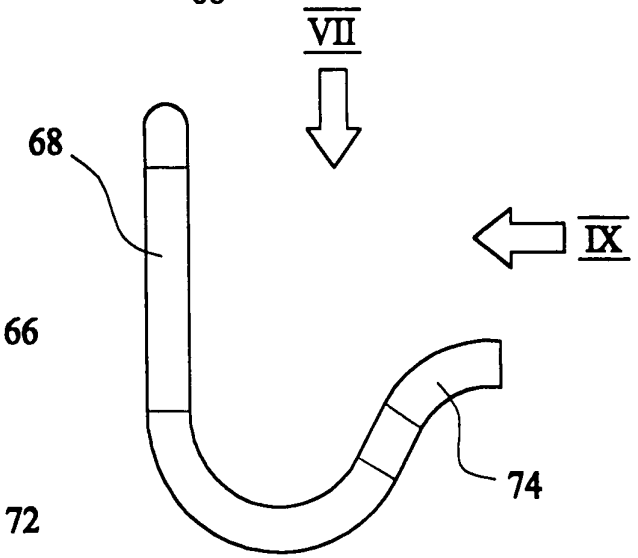


FIG. 8

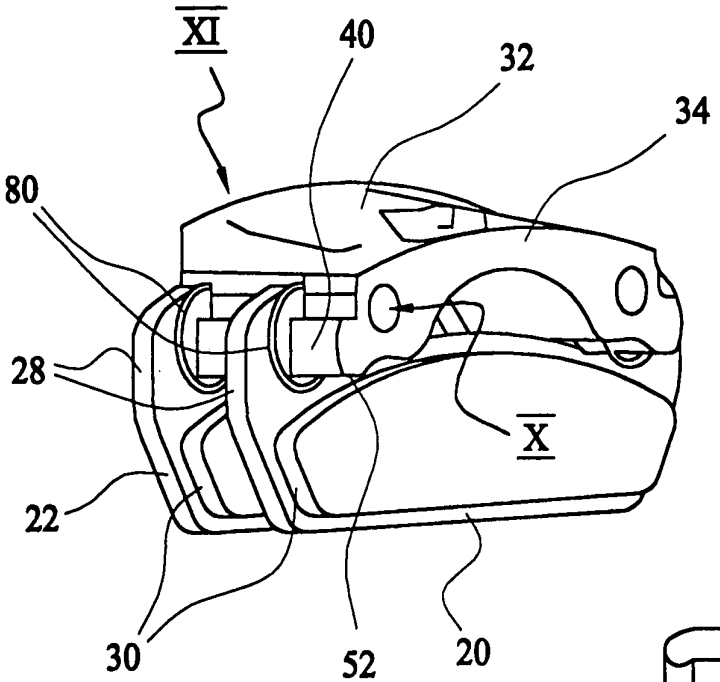


FIG. 10

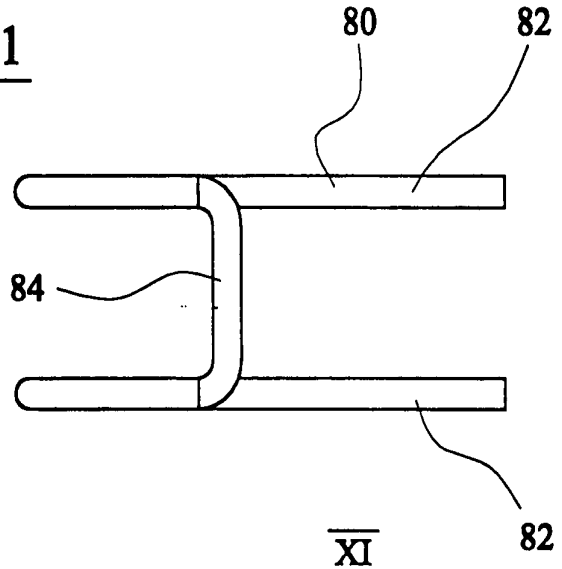


FIG. 11

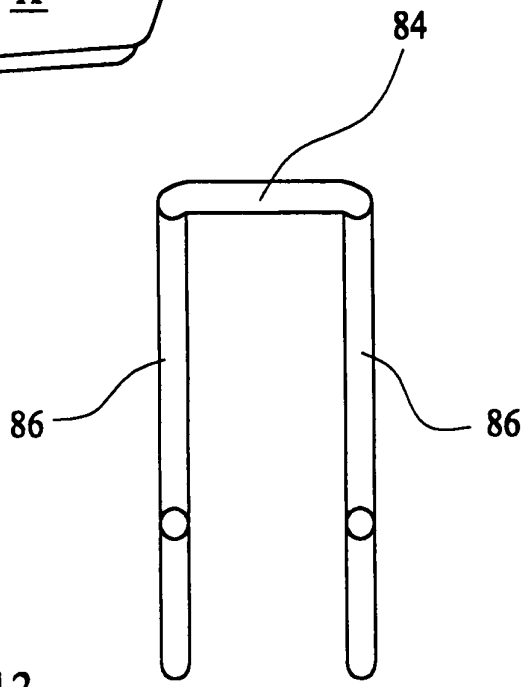


FIG. 13

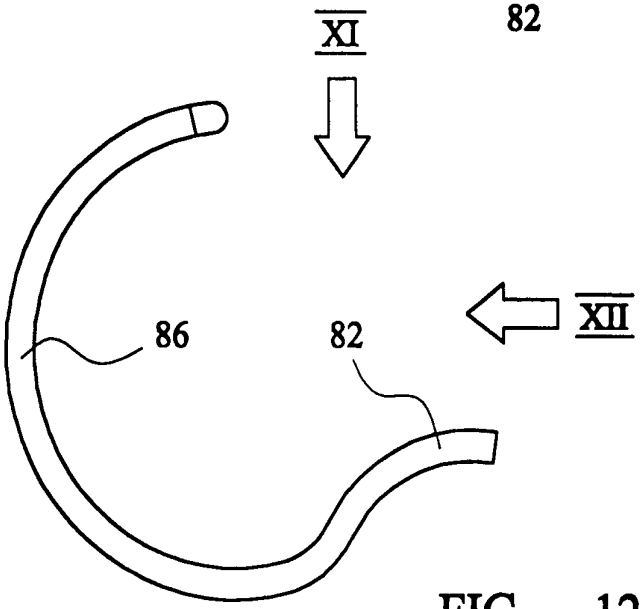


FIG. 12

METHOD AND APPARATUS FOR MOUNTING FRICTION ELEMENTS IN DISC BRAKES

This invention relates to a method and apparatus for mounting friction elements in disc brakes. A particular embodiment of the invention relates to the mounting of friction elements in a disc brake of the kind in which at least one brake disc is axially slidable with respect to its associated rotatable mounting and the friction elements which frictionally engage braking surfaces at opposite sides of the disc are slidably mounted on a fixed caliper or bridge structure which resists movement of the friction elements under the action of the frictional forces generated by engagement of same with the rotating brake disc during actuation of the brake. Certain aspects of the invention may find wider application than strictly in relation to a disc brake of the kind just enumerated.

There are disclosed in WO 98/25804 and WO 98/26192 disc brakes of the kind described above and in which resilient means in the form of a spring is provided both in relation to at least one axially slidable disc and at least one axially slidable friction element or pad.

However, in the previously proposed friction element mounting in disc brakes of the kind described above incorporating one or more axially slidable brake discs, the arrangement adopted for mounting the resilient means in relation to the fixed caliper or bridge structure has been on the basis of using the fixed and stable structure of the caliper or bridge as a mounting for providing the basis or foundation from which the resilient means takes its mounting for exerting the necessary forces on the friction elements. Such an arrangement has been considered a logical

basis for the construction of an assembly in which there is a need for a high degree of structural and operational integrity achievable on the basis of, inter alia, simplicity of structure and assembly, and minimisation of mechanical wear in use, and related factors.

In the embodiments of the above prior proposals there has been adopted the use of a leaf-type spring acting from the caliper or bridge, and mounted thereon by suitable means and with a suitable connection to the friction elements accordingly.

We have discovered that, contrary to and teaching of the prior art, significant and unexpected advantages are achievable by taking the exact inverse of the teaching of the prior art as a basis for resiliently biasing the friction elements.

According to the invention there is provided a method and apparatus as set forth in the independent claims of the accompanying claims. Sub features of the invention are defined in the subordinate claims.

In the described embodiments in most cases there is adopted the format of a wire spring as the resilient means, this format and the adoption of the friction element itself as the mounting basis for the resilient means enables the spring to be conveniently mounted in an extremely simple way, for example by inter-engagement with a suitable formation on the friction element and interaction of a spring end or other portion on the caliper or bridge structure. Such an arrangement lends itself well to simplicity and ease of assembly, relative economy of construction and manufacture, and reliability of operation

in terms of avoidance of entrapment of debris and foreign matter thereby avoiding accumulation of same during use and the inherent consequences of such, while nevertheless effectively providing the necessary spring forces required for the purpose as discussed above.

Whereas in previously proposed leaf spring constructions the fixed bridge or caliper needs to be suitably adapted (eg drilled and tapped to receive cap screws) for mounting the leaf spring, thereby resulting in little clearance between the spring and the road wheel, which is a restrictive factor in wheel assembly design incorporating the brake, and whereas likewise in the prior proposals the leaf spring force varies as the friction element slides with respect to the bridge or caliper, in the embodiments of the invention these short comings are significantly mitigated or even overcome by the simple spring mounting involving no use of fasteners as such and the layout of which provides no space requirement above the caliper or bridge. Moreover, as the friction element slides with respect to the bridge, there is inherently no consequential variation in spring force. A further advantage of the embodiments arises from the fact that where variation in the spring force applied to each of two or more friction elements is required this can even be achieved by means of the same spring or other resilient means by varying the geometry of the structure which acts to load the spring in the required direction. Such flexibility of design is inherent in the simple wire spring format which can be adopted as a result of mounting the resilient means on the friction element, and this is significantly less (if at all) available in relation to the prior art leaf spring arrangement.

In the embodiments of the present invention the disc brake incorporates resilient means both in relation to the mounting of the brake discs on their mounting hub and in relation to the brake friction elements or pads and their fixed mounting or caliper.

The resilient means are of a structure and strength chosen to be capable of, both in the case of the brake discs and in the case of the brake friction elements, maintaining these components of the brake assembly in their required working attitudes with respect to the structures on which they are mounted. In other words, the springs or resilient means for the brake discs are constructed so as to hold the brake discs in non-tilted working attitudes as they rotate prior to braking. Likewise, the resilient means for the friction elements or pads maintain these later structures in their required attitudes with respect to their fixed mounting or caliper. In both cases, the resilient nature of the resilient means permits, under the dynamic conditions arising during use of the vehicle and due to engine vibration and vehicle motion/road surface induced vibration and similar factors, a degree of movement from the defined working position (as opposed to the actual linear axial sliding movement needed to effect friction element-to-disc engagement and disengagement when commencing and terminating braking which is needed under normal conditions of vehicle use.

In this regard, it is to be noted that the resilient means or springs used in the embodiments in relation to the friction elements for maintaining same in their normal untilted attitudes, differ significantly from the springs disclosed in the above-identified WO 98/25804 and WO 98/26192 specifications in which the pad springs are mere

anti-rattle springs not adapted to hold the brake pads against tilting movement, but merely to avoid rattling. Moreover, in the embodiments of the present invention the springs for the discs and for the pads are balanced in terms of their relative loading applied to the discs and the pads in order to achieve the necessary separation of same when braking is discontinued and yet holding the pads and discs against tilting during use. Thus, the spring forces exerted on the pads or friction elements of the present invention are much stronger than those merely to prevent rattling or noise suppression. The spring forces are sufficient to restrain the slidable brake pads or friction elements from moving into contact with the brake discs in an uncontrolled manner. The use of the substantially stronger pad springs in the present embodiment assists in positioning the outer rims of the brake discs in their brake-off position for reducing residual brake torque.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 shows in block diagram format a spot-type automotive disc brake comprising a pair of axially slidable discs and associated friction elements, an actuating mechanism therefor and a fixed caliper or bridge structure overlying same;

Figures 2 to 5 show views of a first embodiment of the invention which is applicable to a disc brake of the kind shown in Fig 1. Fig 2 being a perspective view of a portion of the caliper and an associated friction element and

resilient means mounted thereon;

Figures 3, 4 and 5 being views of the resilient means or spring, on its own, as seen generally in the directions indicated in Fig 2 by arrows III, IV and V respectively;

Figures 6 to 9 show a second embodiment of the invention which is likewise applicable to a disc brake of the kind shown in Fig 1, Fig 6 being a perspective view similar to that of Fig 2 but showing a different form of spring and mounting, Fig 8 being a side elevation view of the spring as seen in the direction of arrow VIII in Fig 6, and on a somewhat larger scale, and Figs 7 and 9 being further views of the spring of Fig 8, as viewed in the direction of arrows VII and IX in Fig 8; and

Figures 10 to 13 show a further embodiment in views corresponding, respectively to those of Figs 6 to 9.

As shown in Fig 1 a spot-type automotive disc brake 10 comprises a pair of rotatable brake discs 12, 14, a rotatable mounting 16 for the brake discs to permit rotation of the discs and which is adapted to drive the brake discs and have exerted thereon the braking effect by the discs when the disc brake 10 is actuated.

Two pairs of friction elements 18, 20 and 22 are provided and are adapted to frictionally engage braking surfaces 24, 26 provided at opposite sides of brake discs 12, 14 to effect braking on actuating actuation means for the brake.

Central friction element 20 is double-sided for frictional engagement with the mutually-inwardly facing braking surfaces 24, 26 of brake discs 12, 14 and is provided with appropriately facing friction pad material accordingly. Friction elements 18, 20, 22 comprise (as shown in Figs 2 and 6) in each case a generally flat metal backing plate 28 and secured thereto and standing proud thereof a body of friction material 30 of known construction for high durability frictional engagement with the relevant braking surface of the relevant brake disc. In the case of central friction element 20, the friction material is provided at both faces of the backing plate 28.

Brake discs 12, 14 are axially slidable in use with respect to their rotatable mounting 16 under the action of friction elements 18, 20, 22 and the actuation means (to be described below) therefor during braking. For example the brake discs may be keyed to the rotatable mounting or hub 16 at three or more locations and resilient means may act there between.

A non-rotatable mounting 32 for friction elements 18, 20,22 is provided comprising a caliper or bridge structure 34 which is mounted on a fixed structure of the vehicle to be braked, for example on the wheel mounting and which straddles the brake discs 12, 14 and also provides a mounting for actuation means 36,38 (indicated diagrammatically) which applies inwardly directed braking forces to the outer friction elements 18, 22, thereby causing frictional engagement with the brake discs 12, 14 and slight sliding movement of those discs with respect to their rotatable mounting 16. In Fig 1 of course it can be seen that the clearances between the structures have been greatly exaggerated for simplicity of diagrammatic

illustration. The actuation means 36, 38 could comprise a pair of piston and cylinder assemblies. However only one such is strictly needed since the actuation means can be one-sided with a fixed structure at one side or the other of the assembly of discs and friction elements (which fixed structure could simply be a stop extending from caliper 34), and against which fixed structure the assembly is pushed by the single actuation means. Further details in this regard may be found in our co-pending applications WO 98/26192 (docket 2558).

Non-rotatable mounting 32 for the friction elements 18 to 22 is adapted to permit sliding movement of the friction elements into and out of frictional engagement with the brake discs while resisting movement of the friction elements under the action of frictional forces generated by engagement of the friction elements with the discs 12, 14. As shown in Figs 2 and 6 the friction elements are slidably mounted on the caliper 34 by means of a pair of laterally-facing guide rails 40 provided one at each side of the caliper 34, and complementarily-shaped groves formed in the friction element backing plates 28 whereby these latter are freely slidingly moveable on the rails 40, with a minimum of clearance or backlash, having regard to acceptable manufacturing tolerances.

Resilient means 44 is provided in relation to the non-rotatable mounting 32 for the friction elements 18 to 22 and is adapted to act between the friction elements (at the opposite sides of the brake discs) and caliper 34 in order to minimise friction element movement and/or noise and/or rattle with respect to the caliper or bridge 34 (and generally in a direction laterally with respect to the direction of inward movement of the friction element to

engage the brake discs on commencing braking), as will be more fully described below.

For this purpose resilient means 44 is provided comprising mounting means 46 (same reference numeral adopted in both figs 2 and 6), such mounting means being adapted to mount the resilient means at the opposite sides of the brake discs 12, 14 (at which braking surfaces 24, 26 are located), and so that the resilient means move with the friction elements towards and away from the discs during use while applying their resilient bias to the friction elements, such bias being notionally directed (on account of the mounting of the resilient means) from the friction element in question to its non-rotatable mounting ie caliper 34.

In simple terms the resilient means 44 is provided in these embodiments in the form of wire springs 48, 50 (Figs 2 to 5 and Figs 6 to 9 respectively) which are mounted on the corresponding friction element backing plate 28 in the different manners to be described more fully below and which engage the underside 52 of the guide rails 40 to apply their resilient bias thereto.

In the embodiment of Fig 2, wire spring 48 is mounted on backing plate 28 by means comprising an aperture 54 formed in the backing plate and through which the wire spring extends. Spring 48 comprises a spring portion 56 in the form of an arm which acts resiliently on underside 52 of guide rail 40 of caliper 34. At the other side of backing plate 28, spring 48 is adapted to cooperate with the backing plate itself by being formed with an arm portion 58 having at its end an in-turned portion 60 which is located in a notch 62 formed in backing plate 28. It can now be

readily seen by reference to Fig 2, and to the detailed structure of spring 48 seen in Figs 3, 4 and 5, that spring 48 effectively applies a turning moment to backing plate 28 (such turning moment being applied by in-turned portion 60 of spring 48) which is generally downwards with respect to the attitude seen in Fig 2. It can be seen that the embodiment of Figs 2 to 5 achieves the required resilient force effect as between the friction element backing plate 28 and the caliper 34 in an extremely simple and economical manner, using only two wire springs (one at each end of the backing plate) per friction element and with the spring arm 56 running on a machined surface (the underside 52 of guide rails 40) thereby achieving constant spring force even when the friction element moves axially. An additional advantage arises from the fact that in this embodiment the spring has a generally unsymmetrical format giving rise to the fact that the spring arm portion 58 acts on the caliper 34 at a position slightly offset from the position at which the in-turned portion 60 of the spring acts on backing plate 28. The resultant couple generated is arranged to act in a direction tending to cause the friction material 30 to be pulled away from the disc upon brake release.

Turning now to the embodiment of Fig 6 to 9, this corresponds in many ways with the embodiment of Figs 2 to 5 and is numbered accordingly. However, wire spring 50 is of a different and symmetrical format and cooperates with a peg 64 extending throughout an aperture formed in backing plate 28 and projecting therefrom both sides so as to cooperate with spaced parallel limbs 66, 68 provided on spring 50.

The symmetrical format of spring 50 is arranged not only to cooperate with peg 64 but so that the transverse bar

portion 70 can locate in notch 62 in backing plate 28 for torque application and mounting purposes while twin limb ends 72, 74 have smoothly curved profiles for sliding engagement with the underside 52 of the guide rails 40 on a symmetrical and balanced basis at each side of backing plate 28.

In this embodiment the general direction of the applied spring force is similar to that in the embodiment of Figs 2 to 5. The same number of springs is needed. A notch may be provide in peg 64 for spring location purposes. Modifications can easily be provided with respect to the spring force (for example for central friction element 20) by changes in the location of peg 64 and/or notch 62).

A further, third, embodiment is shown in figures 10 to 13. In many ways this embodiment corresponds to the two previous embodiments and is numbered accordingly. However, wire spring 80 is of a different symetrically format. As shown, the wire spring 80 comprising twin arcuate main portions 86 which are joined together in a generally parallel relationship by a transverse portion 84. Twin limb ends 82, which have a smoothly curved profile for sliding abutting engagement with the underside 52 of the guide rails 40 extend from each of the arcuate portions 86.

The spring 80 is mounted so that it straddles the friction element with transverse portion 84 located within a notch, not shown (formed in the friction element backing plate, and the two arcuate main portions 86 disposed generally parallel to and adjacent opposite faces of the friction element backing plate. It will be understood that two separate springs 80 are provided for each friction element 20, 22, one at each end thereof. The limb ends 82 of spring

80 bear against the lower surface 52 of the guide rail while the transverse portion 84 bears against the backing plates of the friction element 20, 22.

Due to the resilience of the spring 80 and its arcuate main body portions 86, the spring biases the friction element radially inwardly into engagement with the guide rail 40 and caliper 34. As with the embodiment of fig 6, due to the symmetrical format of the spring 80, the resilient forces exerted on the friction elements 20, 22 provided by the springs 80 will be balanced about the plane of the friction elements. An advantage of this spring arrangement is that no hole or peg in the friction element backing plate is required.

CLAIMS

1. A method of mounting a friction element in a spot-type automotive disc brake, the disc brake comprising:-

a) at least one rotatable brake disc;

b) a rotatable mounting for said brake disc to permit such rotation and which is adapted to drive said brake disc and to have exerted thereon a braking effect by said brake disc when the disc brake is actuated;

c) at least one pair of friction elements adapted to frictionally engage braking surfaces on opposite sides of said brake disc to effect braking on actuation of actuation means therefor;

d) said brake disc being axially slidable in use with respect to said mounting therefor under the action of said friction elements and said actuation means therefor during braking;

e) a non-rotatable axially fixed mounting for said friction elements adapted to permit axial sliding movement of at least one of said friction elements into and out of frictional engagement with said disc while resisting movement of same under the action of frictional forces generated by engagement of same with said at least one disc.

f) resilient means being provided in relation to said non-rotatable mounting and adapted to act between said friction elements at said opposite sides of said disc and said non-rotatable mounting therefor;

characterised by said method comprising:

g) providing said resilient means comprising mounting means therefor adapted to mount said resilient means at said opposite sides of said disc on at least of one of said friction elements so as to move therewith towards and away from said disc during use, and the method comprising

spring adapted to act between a backing plate of said friction element and fixed bridge or caliper providing said non-rotatable mounting.

7. A disc brake according to claim 6 characterised by said wire spring being mounted on said backing plate by means comprising an aperture formed in said backing plate.

8. A disc brake according to claim 7 characterised by said wire spring extending through said aperture and comprising at one side of said backing plate a spring portion adapted to act resiliently on said fixed bridge or caliper and at the other side thereof to cooperate with said backing plate itself.

9. A disc brake according to claim 7 characterised by said means comprising an aperture formed in said backing plate further comprising a peg extending through said aperture and said spring being adapted to cooperate with said peg.

10. A disc brake according to claim 9 characterised by said wire spring being adapted to straddle symmetrically said backing plate and to cooperate with said peg in order to define an attitude of said spring for cooperation with said bridge or caliper.

11. A disc brake substantially as described herein with reference to the accompanying drawings.

12. A method of mounting a friction element in a spot type automotive disc brake substantially as described herein with reference to the accompanying drawings.

The Patent Office
PATENTS • DESIGNS • COPYRIGHT • TRADE MARKS
17
INVESTOR IN PEOPLE

Application No: GB 0010808.4
Claims searched: 1-12
Examiner: David McWilliams
Date of search: 19 September 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): F2E (EEL, EHB)

Int Cl (Ed.7): F16D 65/097

Other: ON-LINE: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2316985 A	FERODO (see spring 20, figure 1, page 4 lines 18-21)	1-7
Y	WO 98/25804 A1	T&N (see spring 70, figure 1, page 7 lines 32-34)	1-7
Y	US 5511638	TOKICO (see figure 3)	1-7
Y	US 5310024	TSURUTA (see figures 2 and 5)	1-7

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.